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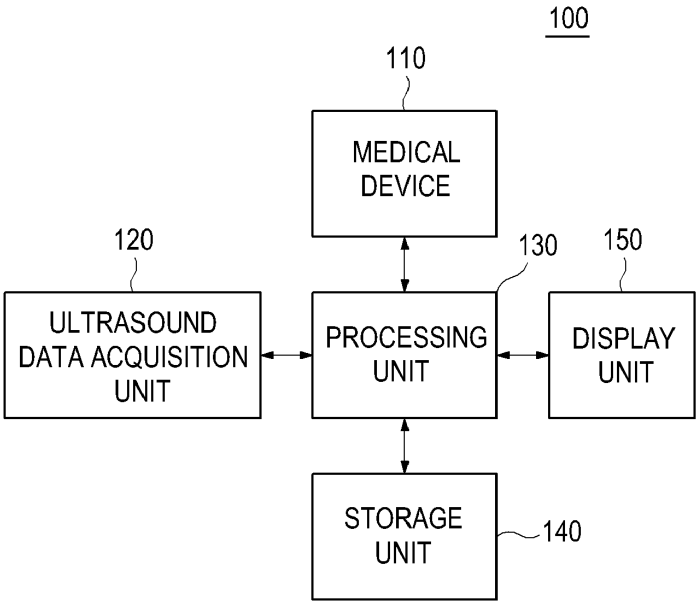
(54) Providing an optimal ultrasound image for interventional treatment in a medical system

(57) Embodiments for providing an optimal ultrasound image for interventional treatment in a medical system are disclosed. In one embodiment, by way of non-limiting example, a medical system comprises: a medical device that is inserted into a target object and configured to remove a lesion within the target object; an ultrasound data acquisition unit configured to transmit and receive ultrasound signals to and from the target object to output ultrasound data; and a processing unit in communication with the ultrasound data acquisition unit, the processing unit being configured to form a plurality of ultrasound images based on the ultrasound data and perform an image processing upon each of the ultrasound images to detect a position of the medical device.

FIG. 1



EP 2 454 996 A1

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority from Korean Patent Application No. 10-2010-0114331 filed on November 17, 2010.

TECHNICAL FIELD

[0002] The present disclosure generally relates to medical systems, and more particularly to providing an optimal ultrasound image for interventional treatment in a medical system.

BACKGROUND

[0003] Surgical treatment using a medical needle such as ablator or biopsy has recently become popular due to relatively small incisions made in such a procedure. The surgical treatment is performed by inserting the medical needle into an internal region of a human body while referring to an internal image of the human body. Such surgical treatment, which is performed while observing internal organs of the human body with the help of a diagnostic imaging system, is referred to as an interventional treatment. The interventional treatment is performed by directing the medical needle to a lesion to be treated or examined through a skin with reference to images during the treatment. The images are acquired by employing a computerized tomography (CT) scanner, which is generally used in a radiology department, or a magnetic resonance imaging (MRI) system. Compared to a normal surgical treatment requiring relatively wide incisions to open the lesion, the interventional treatment has the advantages of low costs and obtaining effective operation results. This is because general anesthesia is not necessary for the interventional treatment and patients are subj ected to less pain while benefiting from rapid recovery.

[0004] However, it is difficult to obtain such images in real time by using the CT scanner or the MRI system. Especially, when the interventional treatment is performed by using the CT scanner, both the patient and the operator are exposed to radiation for quite a long time. However, when the interventional treatment is performed by using an ultrasound diagnostic system, the images can be obtained in real time without affecting the human body. But, there is a problem since it is difficult to accurately recognize the lesion as well as the medical device (i.e., a needle) in the ultrasound image obtained by using the ultrasound system.

SUMMARY

[0005] Embodiments for providing an optimal ultrasound image for interventional treatment in a medical system are disclosed herein. In one embodiment, by way of non-limiting example, a medical system comprises: a medical device inserted into a target object and configured to remove a lesion within the target object; an ultrasound data acquisition unit configured to transmit and receive ultrasound signals to and from the target object to output ultrasound data; and a processing unit in communication with the ultrasound data acquisition unit, the processing unit being configured to form a plurality of ultrasound images based on the ultrasound data and perform an image processing upon each of the ultrasound images to detect a position of the medical device.

[0006] In another embodiment, there is a method of providing an ultrasound image for interventional treatment, comprising: a) inserting a medical device including a needle into a target object; b) transmitting and receiving ultrasound signals to and from the target object to output ultrasound data; c) forming a plurality of ultrasound images based on the ultrasound data; and d) performing an image processing upon each of the ultrasound images to detect a position of the needle.

[0007] The Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used in determining the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 is a block diagram showing an illustrative embodiment of a medical system.

FIG. 2 is a block diagram showing an illustrative embodiment of an ultrasound data acquisition unit.

FIG. 3 is a schematic diagram showing an example of acquiring ultrasound data corresponding to a plurality of ultrasound images.

FIG. 4 is a flow chart showing a process of forming an optimal ultrasound image for interventional treatment in accordance with a first embodiment.

FIG. 5 is a schematic diagram showing an example of a reference ultrasound image and a plurality of sub ultrasound images in accordance with a second embodiment.

FIG. 6 is a flow chart showing a process of forming an optimal ultrasound image for interventional treatment in accordance with the second embodiment.

FIG. 7 is a flow chart showing a process of forming an optimal ultrasound image for interventional treatment in accordance with a third embodiment.

FIG. 8 is a flow chart showing a process of forming an optimal ultrasound image for interventional treatment in accordance with a fourth embodiment.

DETAILED DESCRIPTION

[0009] A detailed description may be provided with reference to the accompanying drawings. One of ordinary skill in the art may realize that the following description is illustrative only and is not in any way limiting.

First embodiment

[0010] FIG. 1 is a block diagram showing an illustrative embodiment of a medical system. As depicted therein, the medical system 100 includes a medical device 110. The medical device 110 includes a needle (not shown) for removing the lesion of a living body and a vibration applying section (not shown) for applying vibration to the needle. However, it should be noted herein that the medical device 110 may not be limited thereto. The living body includes a plurality of target objects (e.g., blood vessels, a heart, a lesion, etc.).

[0011] The medical system 100 further includes an ultrasound data acquisition unit 120. The ultrasound data acquisition unit 120 is configured to transmit and receive ultrasound signals to and from the living body and output ultrasound data.

[0012] FIG. 2 is a block diagram showing the ultrasound data acquisition unit 120 in accordance with the first embodiment. Referring to FIG. 2, the ultrasound data acquisition unit 120 includes an ultrasound probe 210, a transmitting section ("Tx signal generating section") 220, a receiving section ("beam former") 230 and an ultrasound data forming section 240.

[0013] The ultrasound probe 210 includes a plurality of elements (not shown) for reciprocally converting between ultrasound signals and electrical signals. The ultrasound probe 210 is configured to transmit ultrasound signals to the living body based on each of scanlines (not shown). The ultrasound probe 210 further receives ultrasound signals (i.e., ultrasound echo signals) from the living body and output the received signals. The received signals are analog signals. The ultrasound probe 210 includes a convex probe, a linear probe and the like.

[0014] The Tx signal generating section 220 is configured to control the transmission of the ultrasound signals. The Tx signal generating section 220 further generates electrical signals ("Tx signals") in consideration of the elements and focal points. The Tx signals are low frequency (e.g., 2~5MHz) Tx signals or high frequency (e.g., more than 10MHz) Tx signals.

[0015] For example, the Tx signal generating section 220 generates the Tx signals for obtaining each of a plurality of ultrasound images UI_i ($1 \le i$) as shown in FIG. 3, sequentially. Thus, the ultrasound probe 210 converts the Tx signals provided from the Tx signal generating section 220 into the ultrasound signals, transmit the ultrasound signals to the living body and receive the ultrasound echo signals from the living body to thereby output electrical signals ("the received signals").

[0016] The beam former 230 is configured to convert the received signals provided from the ultrasound probe 210 into digital signals. The beam former 230 further applies delays to the digital signals in consideration of the elements and the focal points to output digital receive-focused signals.

[0017] The ultrasound data forming section 240 is configured to form ultrasound data corresponding to the ultrasound images based on the digital receive-focused signals provided from the beam former 230. The ultrasound data forming section 240 is further configured to perform signal processing (e.g., gain control, etc) upon the digital receive-focused signals.

[0018] Referring back to FIG 1, the medical system 100 further includes a processing unit 130 in communication with the medical device 110 and the ultrasound data acquisition unit 120. The processing unit 130 includes a central processing unit, a microprocessor or a graphic processing unit. However, it should be noted herein that the processing unit 130 may not be limited thereto.

[0019] FIG. 4 is a flow chart showing a process of forming an optimal ultrasound image for interventional treatment in accordance with the first embodiment. As explained above, the medical device including the needle is inserted into the target object, and then the ultrasound data are obtained by transmitting and receiving ultrasound signals to and from the target object. The processing unit 130 is configured to form the ultrasound image UI_i based on the ultrasound data provided from the ultrasound data acquisition unit 120, at step S402 in FIG. 4.

[0020] The processing unit 130 is configured to perform motion tracking between the ultrasound image UI_{i-1} and the ultrasound image UI_i to detect a position of the medical device 110 from the ultrasound image UI_i, at step S404 in FIG. 4. The methods of performing the motion tracking are well known in the art. Thus, they have not been described in detail so as not to unnecessarily obscure the present invention.

[0021] The processing unit 130 is configured to perform image processing for enhancing image quality upon the ultrasound image UI_i based on the detected position, at step S406 of FIG. 4. The methods of enhancing the image quality are well known in the art. Thus, they have not been described in detail so as not to unnecessarily obscure the present invention.

[0022] The processing unit 130 is configured to continuously perform the process upon all of the ultrasound images while performing the interventional treatment, as mentioned above, at step S408 in FIG. 4.

[0023] Referring back to FIG. 1, the medical system 100 further includes a storage unit 140. The storage unit 140 stores the ultrasound data acquired by the ultrasound data acquisition unit 120. The storage unit 140 further stores the ultrasound images formed by the processing unit 130.

[0024] The medical system 100 further includes a display unit 150. The display unit 150 displays the ultrasound images formed by the processing unit 130. The display unit 150 further displays the ultrasound images image-processed by the processing unit 130. The display unit 150 includes a cathode ray tube, a liquid crystal display, an organic light emitting diode and the like.

Second Embodiment

[0025] Referring to FIG. 1, the medical device 110 includes the needle (not shown) for removing the lesion of the living body.

[0026] The ultrasound data acquisition unit 120 includes the ultrasound probe 210, the Tx signal generating section 220, the receiving section 230 and an ultrasound data forming section 240, as shown in FIG. 2.

[0027] The ultrasound probe 210 includes the plurality of elements (not shown) for reciprocally converting between ultrasound signals and electrical signals. The ultrasound probe 210 is configured to transmit ultrasound signals to the living body based on each of the scanlines (not shown). The ultrasound probe 210 further receives the ultrasound echo signals from the living body and output the received signals. The received signals are analog signals.

[0028] The Tx signal generating section 220 is configured to control transmission of the ultrasound signals. The Tx signal generating section 220 is further configured to generate electrical signals ("Tx signals") for obtaining ultrasound images in consideration of the elements and focal points. In this embodiment, the Tx signal generating section 220 is configured to form Tx signals for obtaining a reference ultrasound image, which does not steer the scanlines, and Tx signals for obtaining a plurality of sub ultrasound images, which electronically steer the scanlines in different steering angles.

[0029] For example, the Tx signal generating section 220 forms first Tx signals for obtaining a reference ultrasound image UI_R, which does not steer the scanlines (not shown), as shown in FIG. 5. Thus, the ultrasound probe 210 converts the first Tx signals provided from the Tx signal generating section 220 into ultrasound signals, transmit the ultrasound signals to the living body, and receive ultrasound echo signals from the living body to thereby output first received signals. The Tx signal generating section 220 further generates second Tx signals for obtaining a first sub ultrasound image SUI_1, which electronically steers the scanlines in a first steering angle θ_1, as shown in FIG. 5. As such, the ultrasound probe 210 further converts the second Tx signals provided from the Tx signal generating section 220 into ultrasound signals, transmit the ultrasound signal to the living body, and receive ultrasound echo signal from the living body to thereby output second received signals. The Tx signal generating section 220 further generates third Tx signals for obtaining a second sub ultrasound image SUI_2, which electronically steers the scanlines in a second steering angle θ_2, as shown in FIG. 5. Thus, the ultrasound probe 210 further converts the third Tx signals provided from the Tx signal generating section 220 into ultrasound signals, transmit the ultrasound signal to the living body, and receive ultrasound echo signals from the living body to thereby output third received signals. The Tx signal generating section 220 further generates fourth Tx signals for obtaining a third sub ultrasound image SUI_3, which electronically steers the scanlines in a third steering angle θ_3, as shown in FIG. 5. Thus, the ultrasound probe 210 further converts the fourth Tx signals provided from the Tx signal generating section 220 into ultrasound signals, transmit the ultrasound signal to the living body, and receive ultrasound echo signals from the living body to thereby output fourth received signals. The Tx signal generating section 220 further generates fifth Tx signals for obtaining a fourth sub ultrasound image SUI_4 which electronically steers the scanlines in a fourth steering angle θ_4, as shown in FIG. 5. Thus, the ultrasound probe 210 further converts the fifth Tx signals provided from the Tx signal generating section 220 into ultrasound signals, transmit the ultrasound signal to the living body, and receive ultrasound echo signals from the living body to thereby output fifth received signals.

[0030] The beam former 230 is configured to convert the received signals provided from the ultrasound probe 210 into digital signals. The beam former 230 is further configured to apply delays to the digital signals in consideration of the elements and the focal points to output digital receive-focused signals.

[0031] For example, the beam former 230 converts the first received signals provided from the ultrasound probe 210 into first digital signals. The beam former 230 further applies delays to the first digital signals in consideration of the elements and the focal points to output first digital receive-focused signals. Also, the beam former 230 converts the second received signals provided from the ultrasound probe 210 into second digital signals. The beam former 230 further applies delays to the second digital signals in consideration of the elements and the focal points to output second digital receive-focused signals. Also, the beam former 230 converts the third received signals provided from the ultrasound probe 210 into third digital signals. The beam former 230 further applies delays to the third digital signals in consideration of the elements and the focal points to output third digital receive-focused signals. Also, the beam former 230 converts the fourth received signals provided from the ultrasound probe 210 into fourth digital signals. The beam former 230 further applies delays to the fourth digital signals to output fourth digital receive-focused signals. Also, the beam former 230 converts the fifth received signals provided from the ultrasound probe 210 into fifth digital signals. The beam former 230 further applies delays to the fifth digital signals to output fifth digital receive-focused signals.

[0032] The ultrasound data forming section 240 is configured to form ultrasound data based on the digital receive-focused signals provided from the beam former 230. The ultrasound data includes radio frequency data. The ultrasound data forming section 240 further performs signal processing (e.g., gain control, etc) upon the digital receive-focused signals.

[0033] For example, the ultrasound data forming section 240 forms first ultrasound data corresponding to the reference ultrasound image UI_R based on the first digital receive-focused signals. The ultrasound data forming section 240 further forms second ultrasound data corresponding to the first sub ultrasound image SUI_1 based on the second digital receive-focused signals. The ultrasound data forming section 240 further forms third ultrasound data corresponding to the second sub ultrasound image SUI_2 based on the third digital receive-focused signals. The ultrasound data forming section 240 further forms fourth ultrasound data corresponding to the third sub ultrasound image SUI_3 based on the fourth digital receive-focused signals. The ultrasound data forming section 240 further forms fifth ultrasound data corresponding to the fourth sub ultrasound image SUI_4 based on the fifth digital receive-focused signals.

[0034] FIG. 6 is a flow chart showing a process of forming an optimal ultrasound image for interventional treatment in accordance with the second embodiment. The processing unit 130 is configured to form ultrasound images based on the ultrasound data provided from the ultrasound data acquisition unit 120, at step S602 in FIG. 6. For example, the processing unit 130 forms the reference ultrasound image UI_R based on the first ultrasound data provided from the ultrasound data acquisition unit 120. The processing unit 130 further forms the first sub ultrasound image SU_I to the fourth sub ultrasound image SUI_4 based on the second ultrasound data to fifth ultrasound data provided from the ultrasound data acquisition unit 120.

[0035] The processing unit 130 is configured to perform a contour detection upon each of the sub ultrasound images to detect the contour of the medical device 110, at step S604 in FIG. 6. The methods of performing the contour detection are well known in the art. Thus, they have not been described in detail so as not to unnecessarily obscure the present invention.

[0036] The processing unit 130 is configured to compare the detected coutours from each of the sub ultrasound images to extract an optimal sub ultrasound image from the sub ultrasound images based on the detected contour, at step S606 in FIG. 6. For example, the processing unit 130 detects a sub ultrasound image having the contour of a maximum brightness value from the sub ultrasound images, and extracts the detected sub ultrasound image as the optimal sub ultrasound image.

[0037] The processing unit 130 is configured to control display of the reference ultrasound image and the optimal sub ultrasound image, at step S608 in FIG. 6. For example, the processing unit 130 controls that the reference ultrasound image and the extracted sub ultrasound image are displayed in dual form.

[0038] Referring back to FIG. 1, the storage unit 140 stores the ultrasound data acquired by the ultrasound data acquisition unit 120.

[0039] The display unit 150 displays the reference ultrasound image and the optimal sub ultrasound image. The display unit 150 may further display the sub ultrasound images.

Third embodiment

[0040] Referring to FIG. 1, the medical device 110 includes the needle (not shown) and a fluid providing section (not shown). The needle includes a pipe (not shown) therein. The fluid providing section is configured to provide the fluid to the pipe.

[0041] The ultrasound data acquisition unit 120 includes an ultrasound probe 210, the Tx signal generating section 220, the receiving section 230 and the ultrasound data forming section 240, as shown in FIG. 2.

[0042] The ultrasound probe 210 includes the plurality of elements (not shown) for reciprocally converting between ultrasound signals and electrical signals. The ultrasound probe 210 is configured to transmit ultrasound signals to the living body based on each of scanlines (not shown). The ultrasound probe 210 further receives the ultrasound echo signals from the living body and output the received signals. The received signals are analog signals.

[0043] The Tx signal generating section 220 is configured to control the transmission of the ultrasound signals. The Tx signal generating section 220 is further configured to generate Tx signals in consideration of the elements and the focal points. In the embodiment, the Tx signal generating section 220 forms Tx signals for obtaining each of ultrasound images, sequentially. Thus, the ultrasound probe 210 converts the Tx signals provided from the Tx signal generating section 220 into ultrasound signals, transmit the ultrasound signals to the living body, and receive the ultrasound echo signals from the living body to thereby output the received signals.

[0044] The beam former 230 is configured to convert the received signals provided from the ultrasound probe 210 into digital signals. The beam former 230 is further configured to apply delays to the digital signals in consideration of the elements and the focal points to output digital receive-focused signals.

[0045] The ultrasound data forming section 240 is configured to form ultrasound data corresponding to each of the ultrasound images based on the digital receive-focused signals provided from the beam former 230. The ultrasound data forming section 240 is further configured to perform signal processing (e.g., gain control, etc) upon the digital receive-focused signals.

[0046] FIG. 7 is a flow chart showing a process of forming an optimal ultrasound image for interventional treatment in accordance with the third embodiment. The processing unit 130 is configured to form at least one brightness mode image based on the ultrasound data provided from the ultrasound data acquisition unit 120, at step S702 in FIG. 7.

[0047] The processing unit 130 is configured to form Doppler signals based on the ultrasound data provided from the ultrasound data acquisition unit 120, at step S704 in FIG. 7. The methods of forming the Doppler signals based on the ultrasound data are well known in the art. Thus, they have not been described in detail so as not to unnecessarily obscure the present invention.

[0048] The processing unit 130 is configured to calculate velocity components and power components based on the Doppler signals, at step S706 in FIG. 7. The methods of calculate the velocity components and the power components based on the Doppler signals are well known in the art. Thus, they have not been described in detail so as not to unnecessarily obscure the present invention.

[0049] The processing unit 130 is configured to form a color Doppler image corresponding to the fluid flow based on the velocity components and the power components, at step S708 in FIG. 7. The methods of forming the color Doppler image based on the velocity components and the power components are well known in the art. Thus, they have not been described in detail so as not to unnecessarily obscure the present invention.

[0050] The processing unit 130 is configured to perform image compounding upon the brightness mode image and the color Doppler image to form a compound image, at step S710 in FIG. 7.

[0051] Optionally, the processing unit 130 further detects a position of the medical device 110 from the brightness mode image based on the color Doppler image, and performs the image processing for making prominence of the medical device 110 upon the brightness mode image based on the detected position.

[0052] Referring back to FIG. 1, the storage unit 140 stores the ultrasound data acquired by the ultrasound data acquisition unit 120. The storage unit 140 further stores the Doppler signals formed by the processing unit 130.

[0053] The display unit 150 displays the compound image formed by the processing unit 130. The display unit 150 further displays the brightness mode image formed by the processing unit 130. The display unit 150 further displays the color Doppler image formed by the processing unit 130.

<u>Fourth embodiment</u>

[0054] Referring to FIG. 1, the medical device 110 includes the needle (not shown) for remove the lesion of the living body.

[0055] The ultrasound data acquisition unit 120 includes the ultrasound probe 210, the Tx signal generating section 220, the beam former 230 and the ultrasound data forming section 240 as shown in FIG. 2.

[0056] The ultrasound probe 210 includes the plurality of elements (not shown) for reciprocally converting between ultrasound signals and electrical signals. The ultrasound probe 210 is configured to transmit ultrasound signals to the living body based on each of scanlines (not shown). The ultrasound probe 210 is further configured to receive the ultrasound echo signals from the living body to thereby output the received signals.

[0057] The Tx signal generating section 220 is configured to control the transmission of the ultrasound signals. The Tx signal generating section 220 is further configured to generate Tx signals for obtaining each of ultrasound images in consideration of the elements and the focal points.

[0058] The beam former 230 is configured to convert the received signals provided from the ultrasound probe 210 into digital signals. The beam former 230 is further configured to apply delays to the digital signals in consideration of the elements and the focal points to output digital receive-focused signals.

[0059] The ultrasound data forming section 240 is configured to form the ultrasound data corresponding to each of the ultrasound images based on the digital receive-focused signals provided from the beam former 230. The ultrasound data includes phase information. Also the ultrasound data is radio frequency data. However, it should be noted herein that the ultrasound data may not be limited thereto. The ultrasound data forming section 240 further performs signal processing (e.g., gain control, etc) upon the digital receive-focused signals.

[0060] FIG. 8 is a flow chart showing a process of forming an optimal ultrasound image for interventional treatment in accordance with the fourth embodiment. The processing unit 130 is configured to analyze the ultrasound data provided from the ultrasound data acquisition unit 120 to detect a region that phase inversion occurs, at step S802 in FIG. 8. Generally, the phase of sound wave is inverted at a reflection plane when the sound wave is transmitted from a softness medium to a hardness medium, or vice verse. Thus, the processing unit 130 detects the phase inversion region at the reflection plane based on the phase inversion characteristic.

[0061] The processing unit 130 is configured to form the ultrasound images based on the ultrasound images provided from the ultrasound data acquisition unit 120, at step S804 in FIG. 8. The ultrasound image includes a brightness mode image. However, it should be noted herein that the ultrasound image may not be limited thereto.

[0062] The processing unit 130 is configured to perform edge detection upon the phase inversion region of the ultrasound images, at step S806 in FIG. 8. The edge is detected by using an edge mask such as a Sobel mask, a Prewitt mask, a Robert mask, a Canny mask and the like. Also, the edge is detected by using a structure tensor.

[0063] The processing unit 130 is configured to perform an image processing upon the ultrasound data based on the detected edge, at step S808 in FIG. 8. In one embodiment, the processing unit 130 performs the image processing for making prominence of the detected edge upon the ultrasound image.

[0064] Referring back to FIG. 1, the storage unit 140 stores the ultrasound data acquired at the ultrasound data acquisition unit 120.

[0065] The display unit 150 displays the ultrasound image formed at the processing unit 130. The display unit 150 further displays the image-processed ultrasound image.

[0066] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the scope of the principles of this disclosure. More particularly, numerous variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

Claims

1. A medical system, comprising:

a medical device inserted into a target object and configured to remove a lesion within the target object;
an ultrasound data acquisition unit configured to transmit and receive ultrasound signals to and from the target object to output ultrasound data; and
a processing unit in communication with the ultrasound data acquisition unit, the processing unit being configured to form a plurality of ultrasound images based on the ultrasound data and perform an image processing upon each of the ultrasound images to detect a position of the medical device.

2. The medical system of Claim 1, wherein the medical device comprises:

a needle configured to remove the lesion; and
a vibration applying section configured to apply vibration to the needle,
wherein the processing unit is configured to:

form the ultrasound images based on the ultrasound data;
perform motion tracking upon each of the ultrasound images to detect the position of the needle; and
perform an image processing for making prominence of the ultrasound images upon each of the ultrasound images based on the detected position of the needle.

3. The medical system of Claim 1, wherein the ultrasound data acquisition unit is configured to transmit and receive ultrasound signals to and from the target object based on a plurality of steering angles to output ultrasound data,
wherein the processing unit is configured to:

form the plurality of ultrasound images corresponding to the plurality of steering angles based on the ultrasound image;
perform a contour detection upon each of the ultrasound images to detect contour of the medical device; and
compare the detected contours from each of the ultrasound images to extract an optimal ultrasound image from the ultrasound images based on the detected contour.

4. The medical system of Claim 3, wherein the processing unit is configured to extract the optima ultrasound image having the contour of a maximum brightness value.

5. The medical system of Claim 1, wherein the medical device comprises:

a needle including a pipe therein; and
a fluid providing section configured to provide fluid to the pipe,
wherein the processing unit is configured to:

form a brightness mode image based on the ultrasound data;
form Doppler signals based on the ultrasound data;
calculate velocity components and power components based on the Doppler signals;
form color Doppler image corresponding to the fluid flow based on the velocity components and the power components; and
perform an image compounding upon the brightness mode image and the color Doppler image to form compound image.

6. The medical system of Claim 1, wherein the medical device comprises:

a needle including a pipe therein; and
a fluid providing section configured to provide fluid to the pipe,
wherein the processing unit is configured to:

form a brightness mode image based on the ultrasound data;
form Doppler signals based on the ultrasound data;
calculate velocity components and power components based on the Doppler signals;
form a color Doppler image corresponding to the fluid flow based on the velocity components and the power components;

detect a position of the needle from the brightness mode image based on the color Doppler image; and
perform an image processing for making prominence of the brightness mode image based on the detected position of the needle.

7. The medical system of Claim 1, wherein the processing unit is configured to:

detect a phase inversion region based on the ultrasound data, wherein the phase inversion region is defined when a sound wave is transmitted from a softness medium to a hardness medium, or vice verse;
form the ultrasound images based on the ultrasound image;
perform edge detection upon the phase inversion region of the ultrasound images; and
perform an image processing for making prominence upon each of the ultrasound images based on the detected edge.

8. A method of providing an ultrasound image for interventional treatment, comprising:

inserting a medical device including a needle into a target object;
transmitting and receiving ultrasound signals to and from the target object to output ultrasound data;
forming a plurality of ultrasound images based on the ultrasound data; and
performing an image processing upon each of the ultrasound images to detect a position of the needle.

9. The method of Claim 8, wherein the step a) further comprises:

applying vibration to the needle,
wherein the step d) comprises:

performing motion tracking upon each of the ultrasound images to detect the position of the needle; and
performing an image processing for making prominence of the ultrasound images upon each of the ultrasound images based on the detected position of the needle.

10. The method of Claim 8, wherein the step b) comprises:

transmitting and receiving ultrasound signals to and from the target object based on a plurality of steering angles to output ultrasound data,
wherein the step d) comprises:

d1) performing a contour detection upon each of the ultrasound images to detect contour of the medical device; and
d2) comparing the detected contours from each of the ultrasound images to extract an optimal ultrasound image from the ultrasound images.

11. The method of Claim 10, wherein the step d2) comprises:

extracting the optimal ultrasound image having the contour of a maximum brightness value.

12. The method of Claim 8, wherein the step a) further comprises:

providing fluid to a pipe of the needle.

13. The method of Claim 12, wherein the step d) comprises:

forming a brightness mode image based on the ultrasound data;
forming Doppler signals based on the ultrasound data;
calculating velocity components and power components based on the Doppler signals;
forming a color Doppler image corresponding to the fluid flow based on the velocity components and the power components; and
performing an image compounding upon the brightness mode image and the color Doppler image to form compound image.

14. The method of Claim 12, wherein the step d) comprises:

forming a brightness mode image based on the ultrasound data;
forming Doppler signals based on the ultrasound data;
calculating velocity components and power components based on the Doppler signals;
forming a color Doppler image corresponding to the fluid flow based on the velocity components and the power components;
detecting a position of the needle from the brightness mode image based on the color Doppler image; and
performing an image processing for making prominence of the brightness mode image based on the detected position of the needle.

15. The method of Claim 8, wherein the step d) comprises:

detecting a phase inversion region based on the ultrasound data, wherein the phase inversion region is defined when a sound wave is transmitted from a softness medium to a hardness medium, or vice verse;
forming the ultrasound images based on the ultrasound image;
performing edge detection upon the phase inversion region of the ultrasound images; and
performing an image processing for making prominence upon each of the ultrasound images based on the detected edge.

FIG. 1

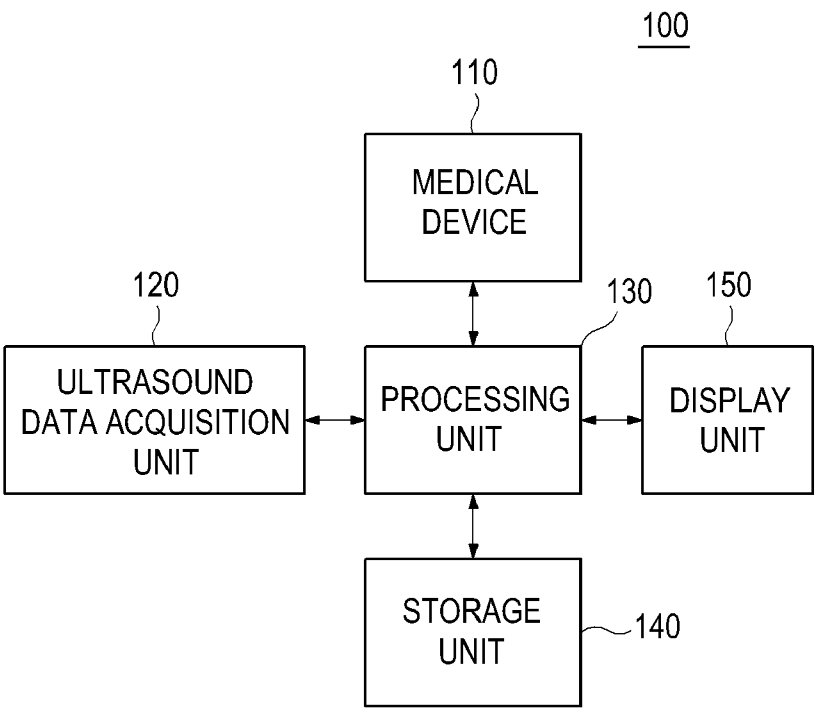

100
110
MEDICAL DEVICE
120
ULTRASOUND DATA ACQUISITION UNIT
130
PROCESSING UNIT
150
DISPLAY UNIT
STORAGE UNIT
140

FIG. 2

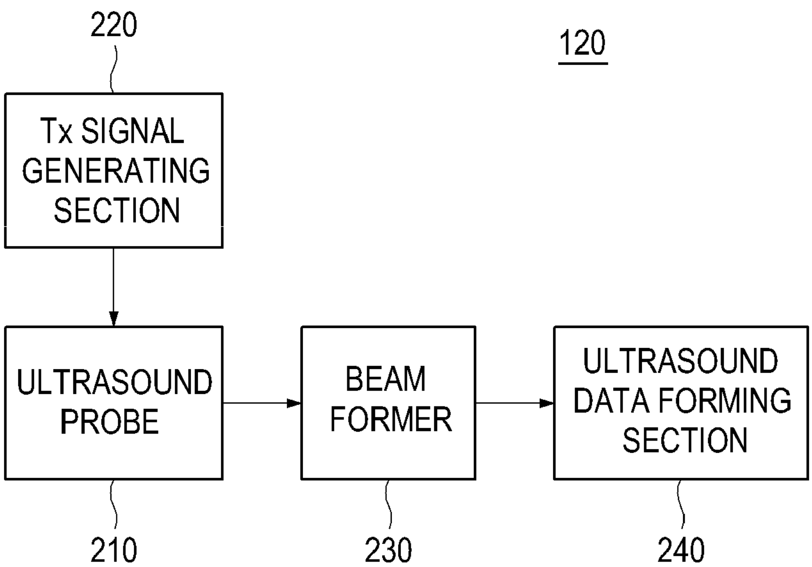

220
120
Tx SIGNAL GENERATING SECTION
ULTRASOUND PROBE
BEAM FORMER
ULTRASOUND DATA FORMING SECTION
210
230
240

FIG. 3

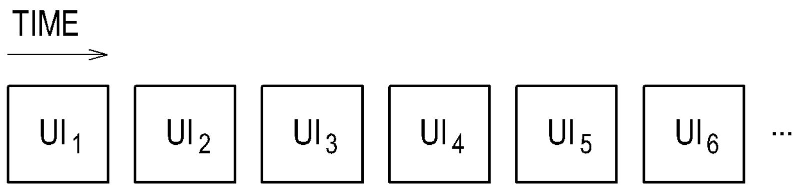

TIME
UI1
UI2
UI3
UI4
UI5
UI6
...

FIG. 4

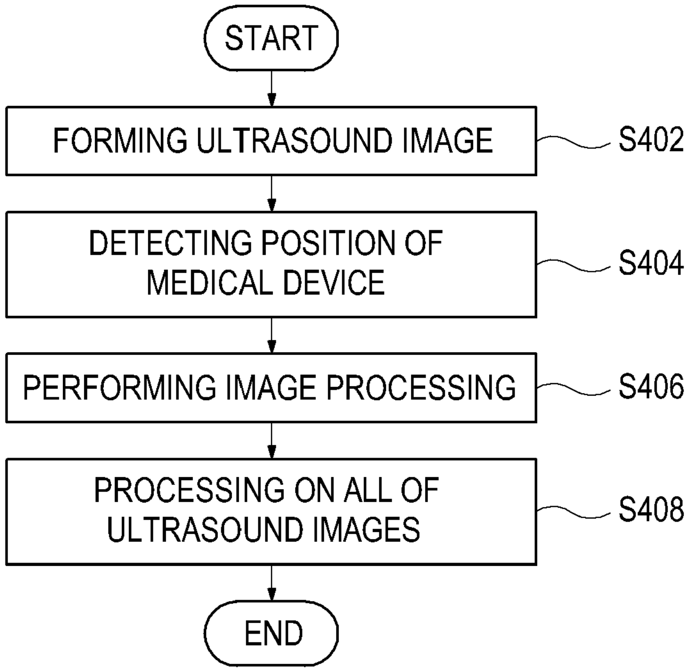

START
FORMING ULTRASOUND IMAGE
S402
DETECTING POSITION OF MEDICAL DEVICE
S404
PERFORMING IMAGE PROCESSING
S406
PROCESSING ON ALL OF ULTRASOUND IMAGES
S408
END

FIG. 5

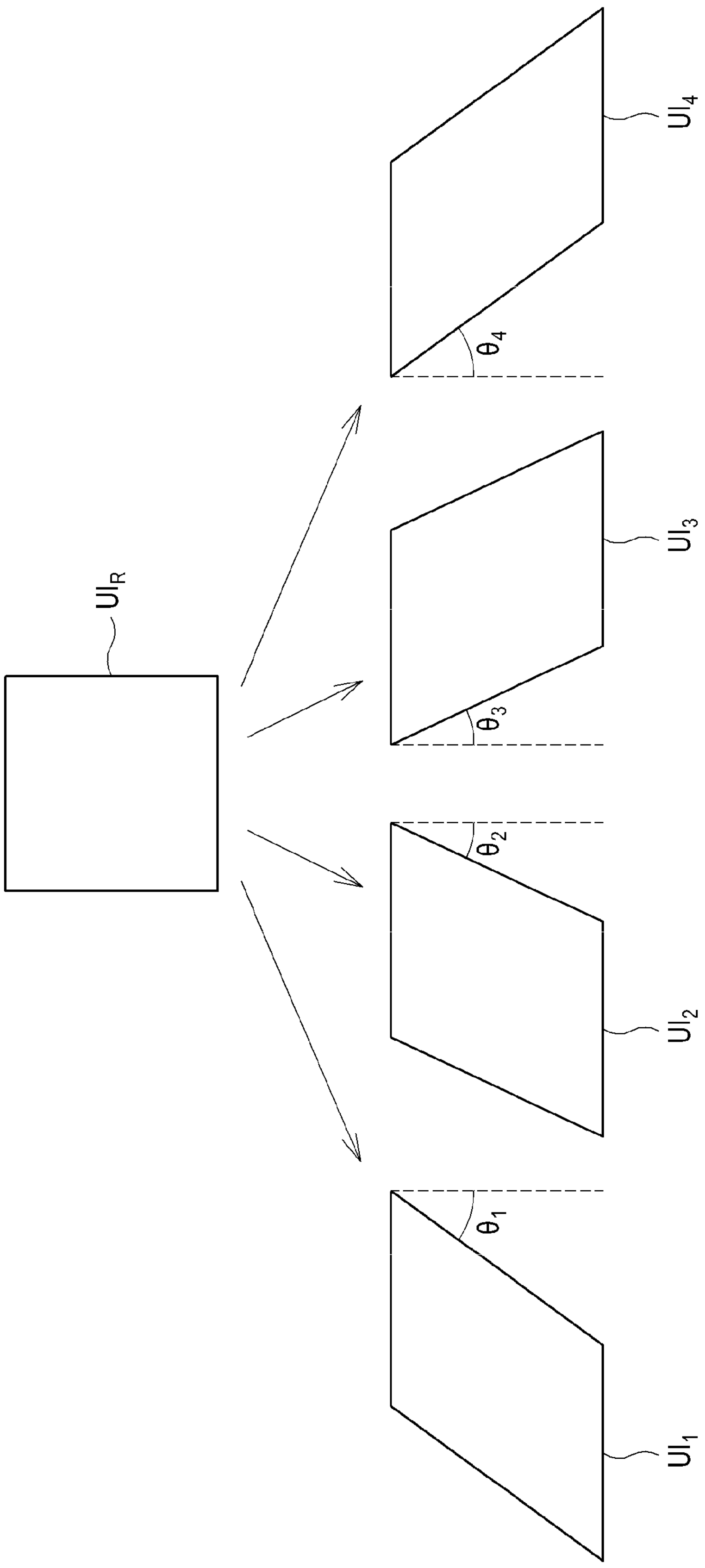


FIG. 6

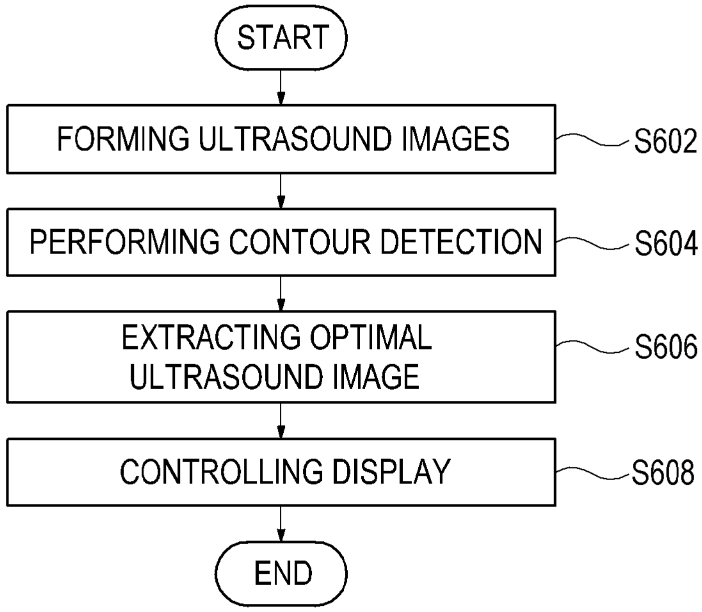

START
FORMING ULTRASOUND IMAGES
S602
PERFORMING CONTOUR DETECTION
S604
EXTRACTING OPTIMAL ULTRASOUND IMAGE
S606
CONTROLLING DISPLAY
S608
END

FIG. 7

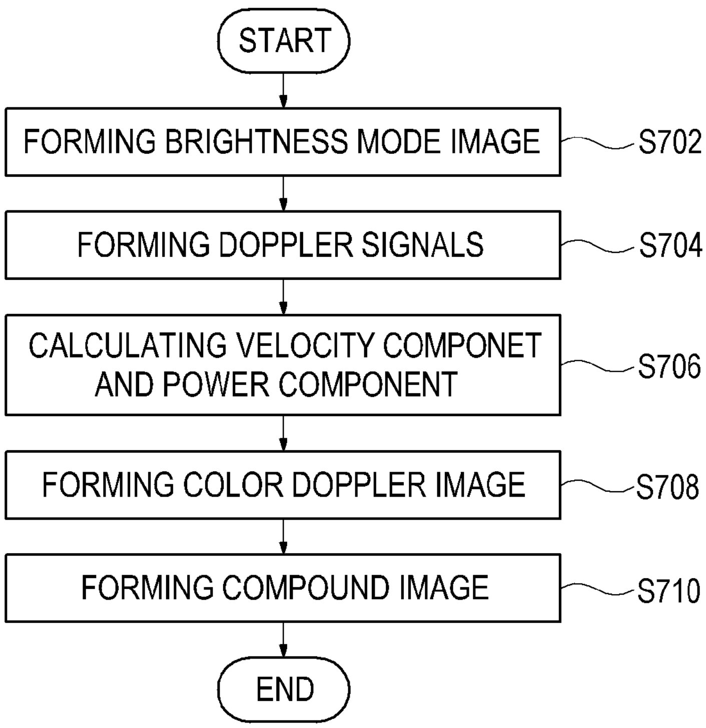
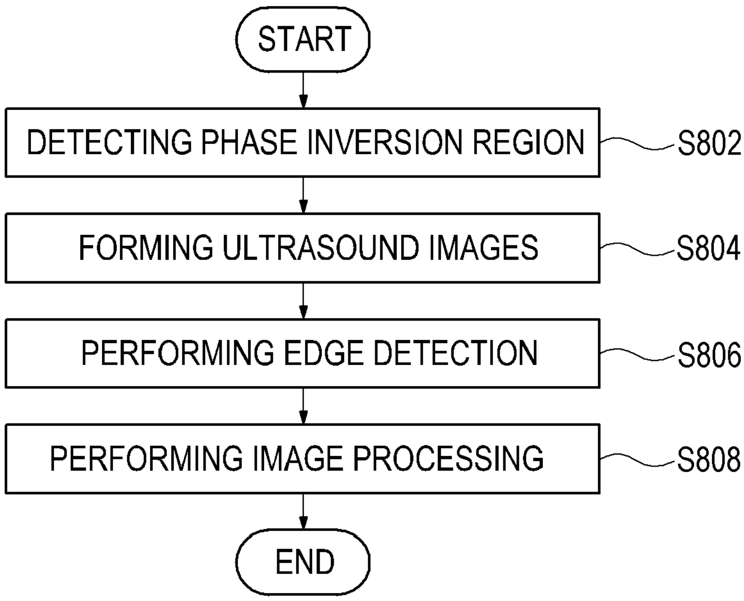

START
FORMING BRIGHTNESS MODE IMAGE
S702
FORMING DOPPLER SIGNALS
S704
CALCULATING VELOCITY COMPONET AND POWER COMPONENT
S706
FORMING COLOR DOPPLER IMAGE
S708
FORMING COMPOUND IMAGE
S710
END

FIG. 8


START
DETECTING PHASE INVERSION REGION
S802
FORMING ULTRASOUND IMAGES
S804
PERFORMING EDGE DETECTION
S806
PERFORMING IMAGE PROCESSING
S808
END

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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
The Hague	19 March 2012	Daoukou, Eleni

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Application Number
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Place of search	Date of completion of the search	Examiner
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